



# Assessing the Vulnerability of Park Resources

## Background

Vulnerability analyses quantify the potential responses of plants, animals, cultural resources, and infrastructure to increasing temperatures, sea level rise, range shifts, extreme events, and other climate change impacts. They identify vulnerable areas and potential refugia, providing key information to prioritize areas for climate adaptation measures.

## Approach

Vulnerability to climate change is the degree to which a system is susceptible to and unable to cope with adverse effects. Robust analyses:

- Examine all three components of vulnerability: exposure (degree of change in climate variables), sensitivity (change of a resource for each increment of change in climate), and adaptive capacity (ability of a species or ecosystem to adjust).
- Analyze historical data and future projections - Because of time lags among the emission of greenhouse gases, the expression of changes in climate, and ecological responses, vulnerability is a function of historical and future climate changes.
- Quantify uncertainties - Computer model errors, future scenario assumptions, statistical variation, and other factors combine to create a range or probability distribution of possible vulnerability values.
- Identify vulnerable areas and potential refugia - This provides scientific data to help prioritize areas for adaptation.

## Published Vulnerabilities

Scientists from the National Park Service (NPS), universities, the U.S. Geological Survey, and other partners have collaborated on analyses of resources in national parks examining the vulnerability of:

### Physical Resources:

- Coasts to sea level rise and storm surge and lake shores to water level changes (22 national parks)
- Air quality to increased nitrogen oxides (25 national parks)
- Melting of glaciers (Glacier National Park)
- Hawai'i coastal ecosystems to sea level rise (2 Hawai'i national parks)

### Plants:

- Biome shifts and habitat fragmentation (up to one-third of the area of the National Park System)
- Forest ecosystems to catastrophic wildfire (Yellowstone and Grand Teton National Parks)
- Joshua trees to range shifts (Joshua Tree National Park)



Published analyses find Yellowstone National Park vulnerable to substantial potential increases in wildfire due to climate change. (Photo: Jeff Henry)

- Arctic vegetation type changes (5 northern Alaska national parks)
- Bristlecone pine and milkvetch to range shifts (3 Utah national parks)
- Eastern tree species to range shifts (Eastern U.S. national parks)

### Wildlife:

- American pika to extirpation (3 California national parks)
- Desert Tortoise and chuckwalla to habitat reduction (Joshua Tree National Park)
- Amphibians to pond drying (Mt Rainier, North Cascades, Olympic National Parks)
- Wading birds to rainfall changes and sea level rise (Everglades National Park)

### Cultural Resources:

- Historical monuments to flooding (Washington, DC national parks)
- Archaeological sites and museum collections to physical damage (Badlands National Park)

### Infrastructure:

- Coastal buildings and roads to sea level rise and storm surge and lake level changes (22 national parks)

## More Information

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